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23 SEP 2003

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A30222

2. Patent application number

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0322269.23. Full name, address and postcode of the or of each applicant (*underline all surnames*)

BRITISH TELECOMMUNICATIONS public limited company
81 NEWGATE STREET
LONDON, EC1A 7AJ, England
Registered in England: 1800000

Patents ADP number (*if you know it*)**1867002** ✓

If the applicant is a corporate body, give the country/state of its incorporation

UNITED KINGDOM

4. Title of the invention

BROADBAND TELECOMMUNICATIONS5. Name of your agent (*if you have one*)

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Country

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Number of earlier application

Date of filing
(*day/month/year*)8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (*Answer 'Yes' if:***YES**

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Description 4

Claim(s) 2

Abstract

Drawing(s) 3 43

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Priority Documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

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Any other documents (please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature(s)

Date:

23 September 2003

LLOYD, Barry George William, Authorised Signatory

12. Name and daytime telephone number of person to contact in the United Kingdom

Rod Hillen

020 7492 8140

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1
DUPLICATE

Broadband Telecommunications

In recent years, particularly with increasing use of the internet, there has been an upsurge of interest in providing higher data rates to users. One objective of development in this area, in countries with a heavy historical investment on copper access networks, has been to make use of existing twisted-pair telephone lines. One result of this has been the Asymmetrical Digital Subscriber Line (ADSL) approach in which it was found that an existing copper pair from a telephone exchange to a telephone subscriber's premises could, using suitable modulation techniques, support significant downstream data rates, of the order of 1.5Mbit/s. However the actual rate obtained in practice depends on the quality and length of the path from the exchange and an alternative proposal, providing higher data rates is to make use of the copper pair only from some point rather closer to the user. This is sometimes referred to as very high speed Digital Subscriber Line (VDSL), and these technologies tend to be referred to generically as "xDSL".

Figure 1 illustrates such an "fibre to the cabinet" arrangement. A telephone exchange 1 provides telephony service via cables 2 (perhaps containing 1000 twisted copper pairs) to street cabinets (or cross-connect points) 3, from which rather smaller twisted-pair cables 4 feed distribution points 5. Individual twisted pairs 6 feed from the distribution point to subscriber's premises 7 to feed telephone equipment 8. Broadband service is provided from the exchange 1 by a multiplexer/demultiplexer 9 which multiplexes signals, using ATM or SDH techniques, onto one or more optical fibres 10, feeding the cabinet 3, and similarly demultiplexes signals travelling in the opposite direction. Within the cabinet 3 is (for each fibre) an optical receiver 11 and transmitter 12, demultiplexer 13, multiplexer 14 and xDSL modems 15 which are then connected via filters 16 to the copper pairs of the cable 4 leading to the distribution point 5 and thence via the pairs 6 to the subscriber premises 7 where a filter 17 separates (in the case of downstream signals) and combines (for upstream traffic) conventional telephony signals on the one hand and xDSL signals for data equipment 18 on the other. A power supply 19 is also provided in the cabinet to supply power to the receivers 11, transmitters 12, demultiplexers 13, multiplexers 14 and modems 15.

According to the present invention there is provided a telecommunications network comprising:

a telephone exchange;

electrical transmission lines connecting the exchange to user terminations;

5 data transmission means;

optical transmission lines connecting the data transmission means to at least one interface, located between the exchange and user terminations, for converting optical signals from an optical transmission line into electrical signals for transmission over one of the electrical transmission lines;

10 wherein, for each of a plurality of user terminations requiring data service:

(a) a dedicated one of said optical transmission lines is provided;

(b) the data transmission means comprises modulation means for converting input data signals into output signals suitable for transmission over the electrical transmission lines, followed by means for modulating the output signals onto an

15 optical signal;

(c) the interface has optoelectrical conversion means arranged to recover said output signals and feed them to the electrical transmission line serving the relevant user termination.

Some embodiments of the invention will now be described, by way of
20 example, with reference to the accompanying drawings.

Figure 2 shows part of a telecommunications system in accordance with a first version of the invention, which is similar to that shown in Figure 1 in that it utilises optical fibre from the exchange to the cabinet, whilst from the cabinet to the subscriber premises it shares the twisted-pair lines with conventional telephony. In
25 this arrangement, however the aim is to reduce the amount of electronics installed in the cabinet. In this particular version, the optical fibre is used only for downstream transmission; upstream data transmission (if required) is provided using the copper pairs from the subscriber premises to the exchange, using the same techniques as in a conventional ADSL system, via modulators 30 in the subscriber's data equipment
30 to demodulate data from the exchange. This system is an example of the invention.

fibres 10, so one fibre 10 is provided for each of the subscriber lines 6 that is to be provided with broadband service. No demultiplexers are employed in the cabinets 4. Moreover, appropriate modulation for converting digital data into a form suitable for downstream transmission on the twisted pairs 4, 6 is provide by xDSL modulators 32 in the exchange 1. These modulators are conventional and operated in the same manner as the modulator parts of the modems 15 of Figure 1, using any technique suited to the purpose, for example, discrete multitone (DMT) modulation, or carrierless amplitude/phase (CAP) modulation. The modulated output of each modulator then modulates a laser 33.

10 In the cabinet 4, it is merely necessary to convert the modulated optical signal received over the fibre 10 into electrical form, and apply this signal via a suitable high-pass filter 34 to the appropriate pair within one of the cables 4. In this, the simplest implementation of the invention, this conversion is performed by zero-bias PIN photodiodes 35, and then supplied to the cables 4 via high-pass filters 26.
15 No power supply to the cabinet is required. Since the frequencies would be low (less than 1GHz) a large area diode could be used, allowing simple low cost alignment, and high power operation (typically 0 to +10 dBm).

At the subscriber premises, the downstream signals are received from the splitter/combiner 16 (shown as separate high-pass and low-pass filters 16a, 16b) by
20 an xDSL demodulator 36.

Note that it is not necessary that the interface between the fibres 10 and the copper cabling should occur in the cabinet 4, as it could equally well occur at the distribution point 5 or indeed other intermediate location between the exchange and the subscriber's premises.

25 If however it is preferred to provide photodiode bias, this could be provided by means of a local power supply, by drawing power from the d.c. applied by the exchange to the line 2 (for example as shown at 39 in Figure 2 for one diode), or by supplying power from the subscriber premises over the pair 6.

If one prefers not to provide an upstream data path using copper all the way
30 back to the exchange as envisaged in Figure 2, then one could use the fibres bidirectionally, as illustrated in Figure 3. Here the downstream arrangements are as

described with reference to Figure 2, but the subscriber has an xDSL modem 40 which is entirely conventional. In the cabinet 3, the upstream signals from the line 4 are fed via a high-pass filter 41 to a laser diode 42 to generate an optical signal which is received by a photodiode 43 at the exchange 1 and supplied to an xDSL
5 modem 44. The high-pass filters 36,41 are tuned to the respective parts of the frequency spectrum corresponding to downstream and upstream signals respectively. Note that in fact it is not essential that the equipment 33, 43, 44 be sited at the exchange 1, as they could if desired be at some other exchange, or any other location to which the fibres 10 can conveniently be connected.

10 In a yet further modification, the photodiode 35 and laser 42 in Figure 3 could be replaced by an electroabsorption modulator serving both to detect the downstream optical signal, and modulate the signal for the upstream path. It employs a two way fibre link from the cabinet to the exchange and utilises an electroabsorption modulator to both detect the optical signal on the down path, and
15 modulate the signal for the return path. xDSL modulation would be applied to the laser within the exchange which would terminate optically on the modulator either in the cabinet or at the DP. The return xDSL signal from the subscriber end would be applied to the modulator which in turn would modulate the optical signal reflected back to the exchange. Given that the upstream and downstream signals are
20 separated in frequency, demodulation becomes a matter of appropriate passive filtering. It is envisaged that the modulator would operate in reflection mode thus requiring only one fibre. Separate contacts could be used to define detector and modulator sections which could be combined with dual wavelength operation.

Electroabsorbtion modulators are described in our international patent
25 application WO98/04057.

CLAIMS

1. A telecommunications network comprising:
 - a telephone exchange;
 - 5 electrical transmission lines connecting the exchange to user terminations;
 - data transmission means;
 - optical transmission lines connecting the data transmission means to at least one interface, located between the exchange and user terminations, for converting optical signals from an optical transmission line into electrical signals for transmission over
 - 10 one of the electrical transmission lines;
- wherein, for each of a plurality of user terminations requiring data service:
 - (a) a dedicated one of said optical transmission lines is provided;
 - (b) the data transmission means comprises modulation means for converting input data signals into output signals suitable for transmission over the electrical
 - 15 transmission lines, followed by means for modulating the output signals onto an optical signal;
 - (c) the interface has optoelectrical conversion means arranged to recover said output signals and feed them to the electrical transmission line serving the relevant user termination.
- 20
2. A network according to claim 1 including data reception means, connected at the exchange to the electrical transmission lines for receiving data from the user terminations.
- 25 3. A network according to claim 1 including data reception means, connected to the optical transmission lines for receiving data from the user terminations, wherein the interface includes electrooptical conversion means arranged to receive signals from

the electrical transmission lines and feed them to the optical transmission line serving the relevant user termination.

4. A network according to claim in which the optoelectrical conversion means and
5 the electrooptical conversion means are together provided by an electroabsorption modulator.
5. A network according to claim 1, 2 or 3 in which the optoelectrical conversion means is a zero-bias photodiode.
- 10 6. A network according to claim 1, 2 or 3 in which the optoelectrical conversion means is a photodiode, and including means to draw power from the electrical transmission lines for providing photodiode bias.

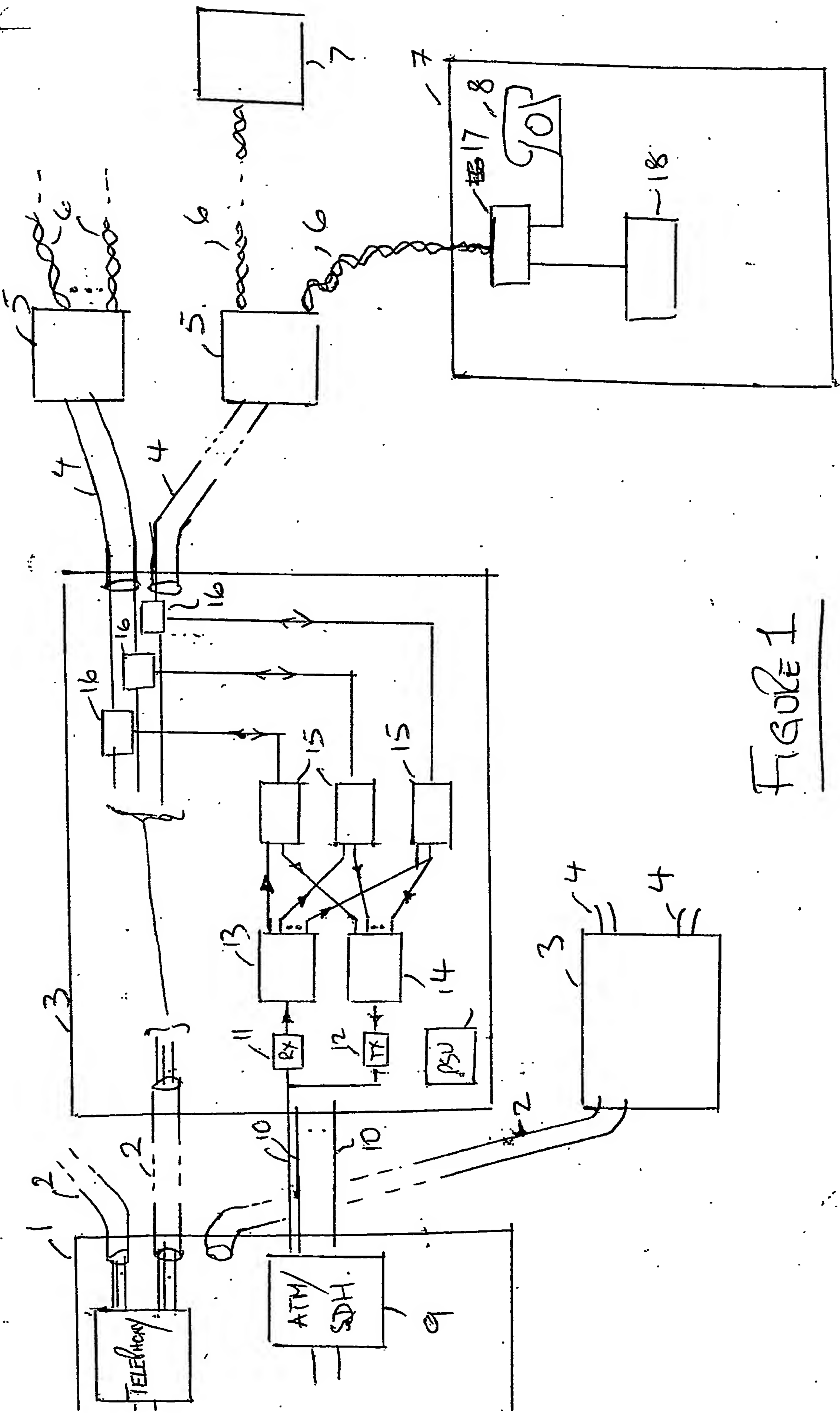


FIGURE 1

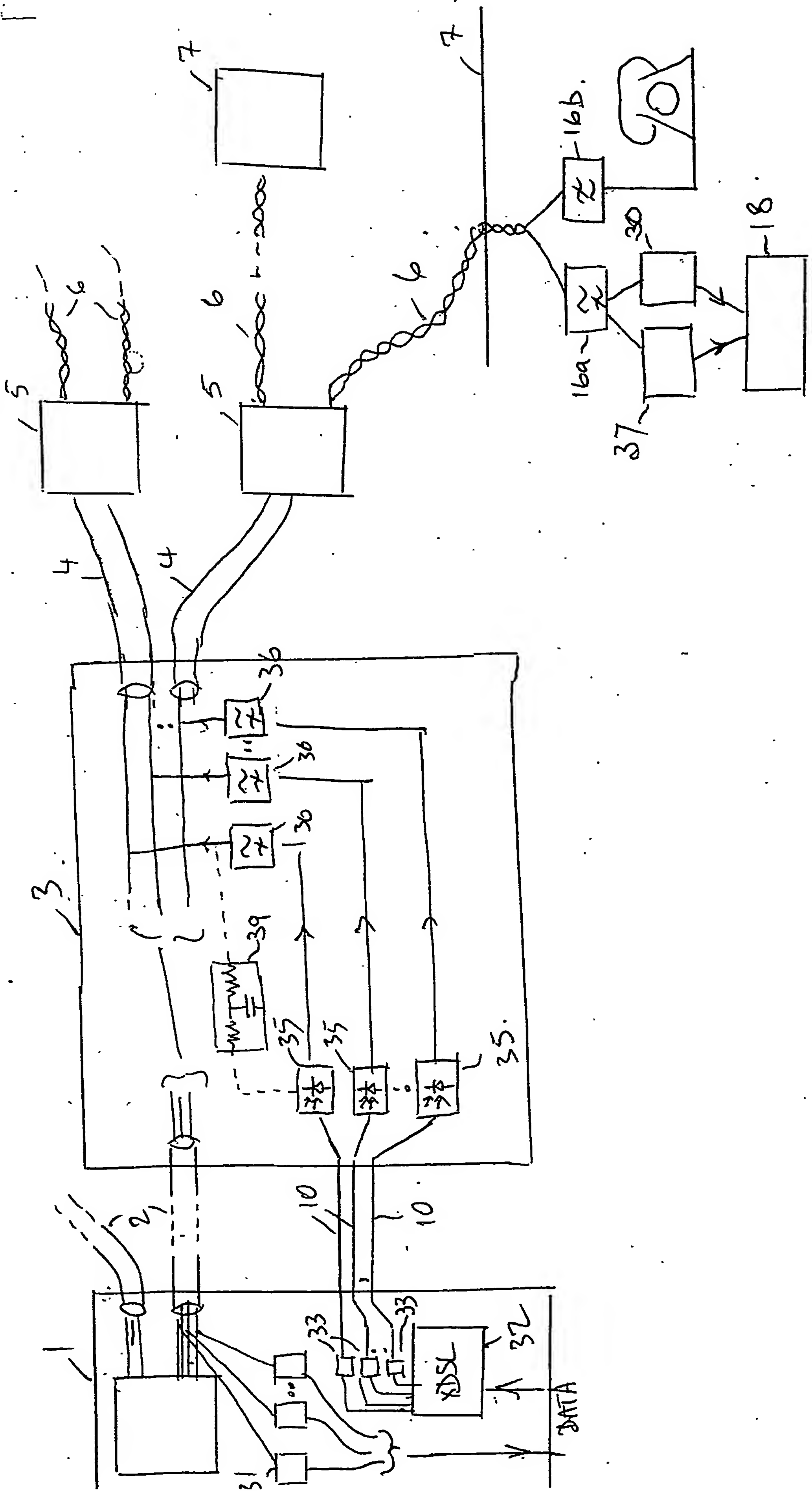


Figure 2

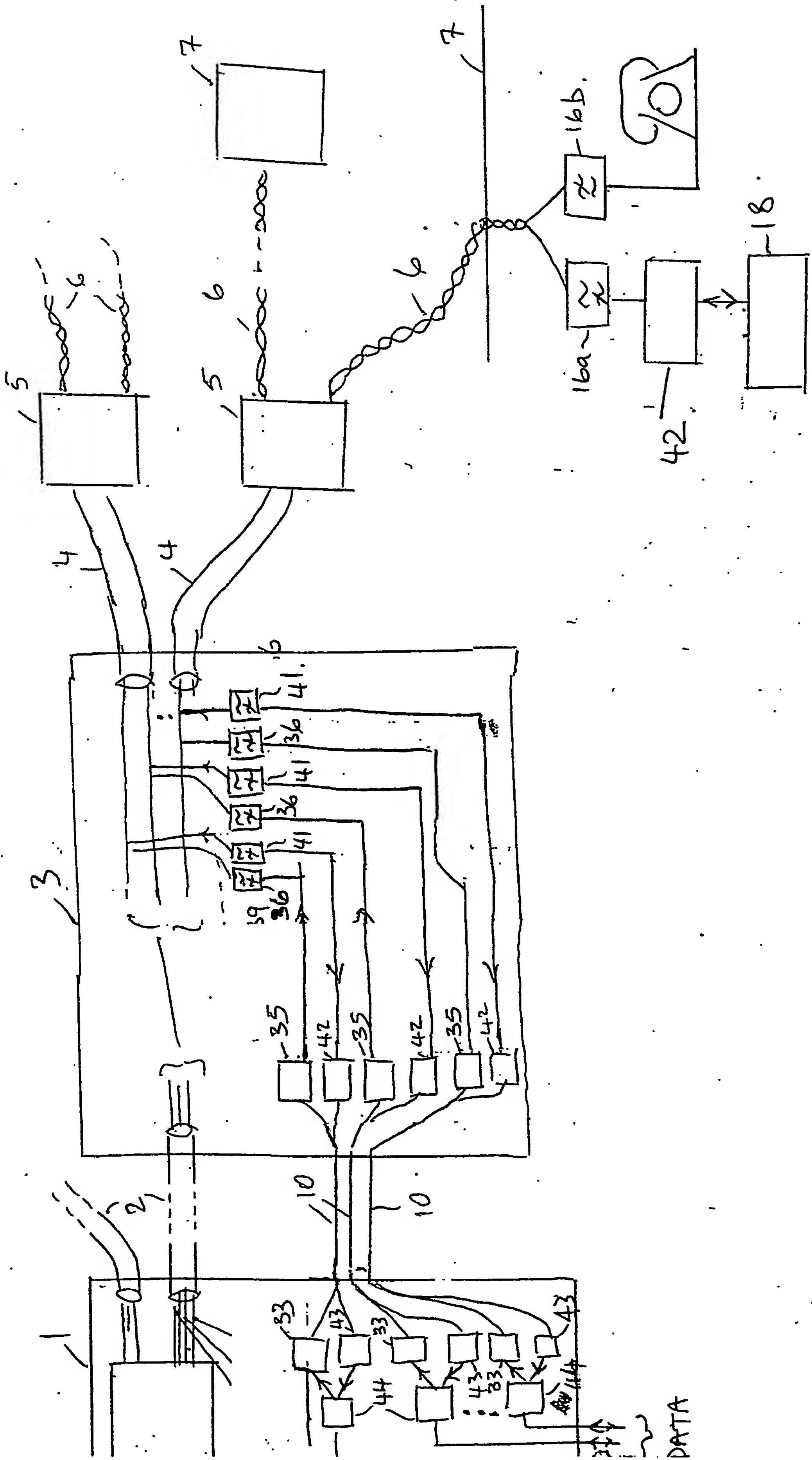


Figure 3

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